

ABSTRACT

An improved apparatus for hemodialysis treatment includes an ultrasonic module with an ultrasonic transducer coupled to a membrane or hollow fiber dialyzer. An ultrasonic waveform generator is switchable between various modes, including a narrowband sine wave, a variable or sweeping frequency sine wave and a broadband square or sawtooth waveform. A low power setting is used to increase the diffusion rate across the semipermeable membranes of the dialyzer and a high power setting is used intermittently to break up thrombus that may form within the dialyzer. A chamber downstream of the dialyzer has an ultrasonic or optical emboli detector for detecting thrombi or emboli exiting the dialyzer and a focused ultrasonic transducer to break up any emboli in the chamber. A screen or filter at the exit of the chamber prevents thrombi and emboli larger than a certain size from entering the patient's circulatory system.